

Broadband wireless discussion with the FCC

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Larry Lang

VP & GM

Mobile Wireless Group

Cisco Systems

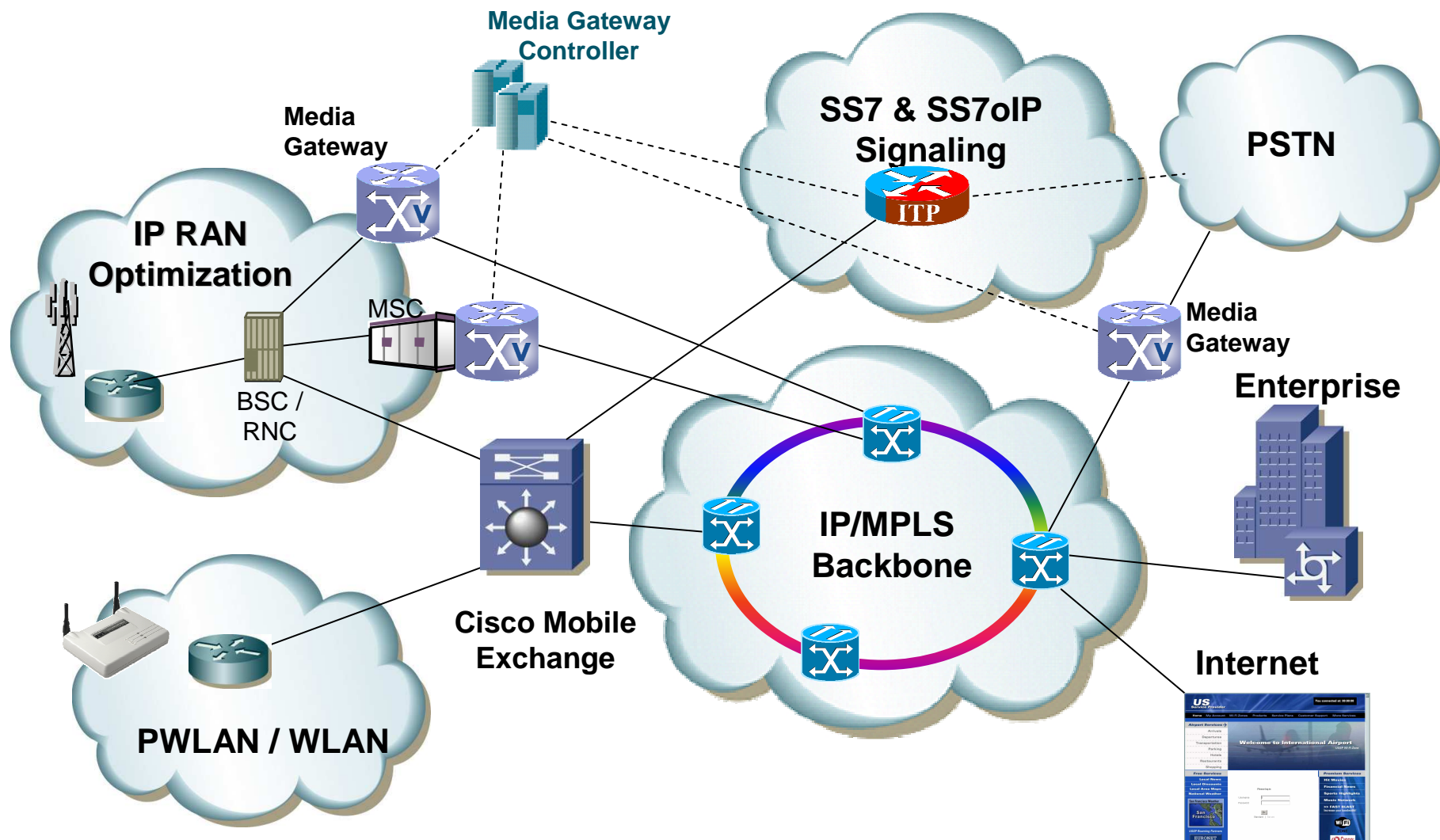
Why broadband is important

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- **The two most important communications services in the world today are the Internet and mobile telephony**
- **Both have had a profound impact on productivity and global competitiveness**
- **Broadband is central to being able to effectively consume Internet services**
- **And mobile broadband is central to being able to consume these services while on the move**
- **Access to information anytime and anywhere will be a crucial competitive differentiator for people, companies, and countries**
- **Broadband and more specifically -- mobile broadband -- is a key enabler**

Cisco and wireless service providers

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Wireless broadband opportunity analysis

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- **Rural Broadband**

We believe that broadband will soon be as essential to day-to-day life as basic phone services. As a result, we are pursuing a number of wireless alternatives to help bring broadband to underserved areas

The demand is certainly there and we are seeing RFP activity in all theatres, especially in Europe (some are subsidized)

- **Metro Broadband (a 3rd competitor to cable and DSL)**

We are also looking at how wireless can play a role as viable competitor to DSL and cable in those areas that are already well served by wired solutions

This has traditional been a very tough market for wireless

We pursued this opportunity in the past (Clarity) and have learned much from that experience

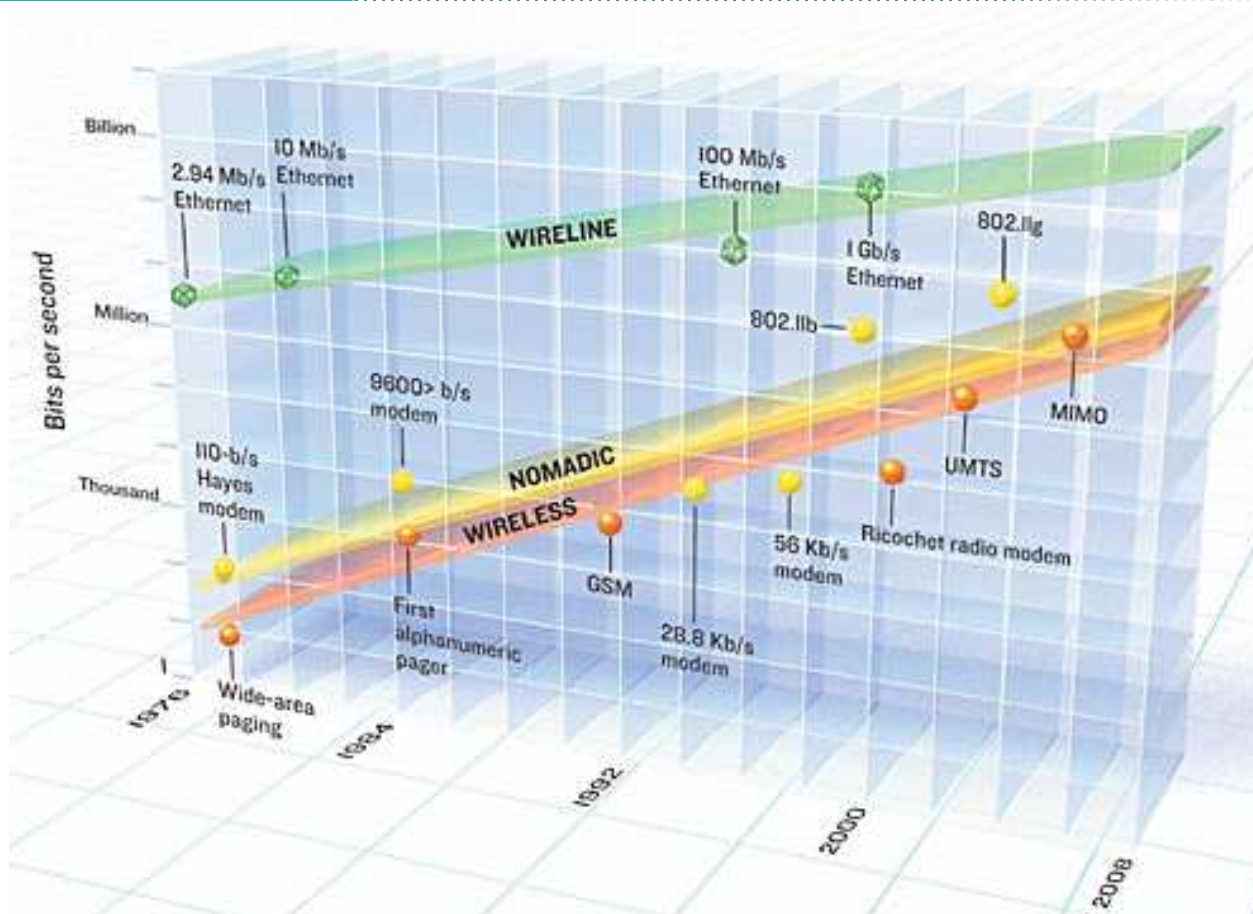
Fixed wireless in metro areas

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- Fixed wireless will have trouble competing with DSL and cable in metro areas
- Wired solutions have too many advantages:
 - Vendors have driven down the cost of equipment as volumes have risen
 - Operators have gotten very efficient at provisioning services
 - Services piggyback off of plant that was put in for other reasons
 - Services will only get faster as new technologies are deployed
 - And fiber is slowly make its way out to the home & business
- *Whereas fixed wireless has to deal with:*
 - Expensive proprietary technologies that have not enjoyed the economies of scale of the wired solutions*
 - Spectrum can be expensive*
 - The need to build new infrastructure (base stations, backhaul, etc)*
 - Truck rolls are often required to provision services*
 - May need to start from scratch with customer acquisition*
 - It's a tough market!*

Comparing Wireline and Wireless Bandwidth Growth

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- **Telecom Rules:** Wireline, nomadic, and wireless technologies improve in a manner reminiscent of Moore's Law. Soon, even slower communications channels like cellphones and radio modems will eclipse the capacity of early Ethernet, thanks to upcoming standards known as UMTS and MIMO, which will boost bandwidth by maximizing antenna usage. [Time axis shows dates of first use.]

Source: *IEEE Spectrum*, July 2004 Illustration: Bryan Christie

But it doesn't have to be

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- **To compete with DSL and cable in metro areas broadband wireless must go mobile**

Mobile broadband will be used as a replacement for wired broadband in situations where the subscriber values mobility over performance or low price

- **The great advantage that a wireless service offers is in its ability to support mobility**
- **Without this UNIQUE differentiator, it would be hard to justify the large investment in spectrum, base stations, backhaul, site acquisition, customer acquisition, etc. that would be required to launch a service**
- **Mobile operators are starting to address the opportunity with 3G and 3G-like offerings that are beginning to rollout**
 - What can be done to accelerate this rollout
- **What can the FCC do to help...**

It's all about spectrum

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- A broadband mobile service requires licensed spectrum
- Best if its in the lower frequency bands:
 - Lowens the investment required to launch a service
 - Can better penetrate buildings, which will increase the usefulness of the technology in the minds of subscribers
- Number of base stations required for an equivalent coverage area goes down sharply as we move down the frequency band.
- General rule of thumb is as follows:
 - 450 Mhz would require 1 base station
 - 900 Mhz would require 3 base stations
 - 1.8 Ghz would require 12 base stations
- *The industry needs the FCC to open up new licensed bands below 800 Mhz for mobile broadband*

Technology options for mobile broadband

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- **3G data overlays like EVDO and HSDPA**

Should provide good data performance. Well integrated with CDMA and W-CDMA infrastructure that is rolling out in all theatres

- **802.20**

Lead vendor here is Flarion. The standards effort has stalled of late, but they continue to move forward with proprietary technology. Hearing good things from the Nextel trials, and RAN vendors have started to take notice. There are other vendors in this space

- **802.16e**

WiMAX forum is generating lots of interest and INTEL is pushing very hard. This technology could certainly play a role in broadband mobile data and INTEL has the where-with-all to drive cost out of client devices which is a big plus

- **802.11a,b,g...**

Cisco is a major vendor here. Used in the enterprise, the home and in public hotspots. It will be extended for higher speeds, greater range, and even mobility

Now we shift gears and look at fixed wireless in rural areas

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- This is an obvious opportunity for fixed wireless technology as the subscriber densities are usually not there to support an extensive wired build-out

Many of the negatives of fixed wireless vs. wired go away when wired solutions become impractical

- There are a number of fixed wireless options for going after this market
- Cost always dominates in access, especially in rural areas where subscriber density is low.... and low cost is often tied to standards activity and volume
- A couple of IEEE standards can help here
 - The enormously successful 802.11 (WiFi) standard with very low prices and very high volumes (driven by enterprise and home deployments)
 - The emerging 802.16 (WiMAX) standard for fixed wireless which could go in the same direction (if it succeeds as a mobile broadband solution)
- And other technologies will undoubtedly emerge to address specific market opportunities

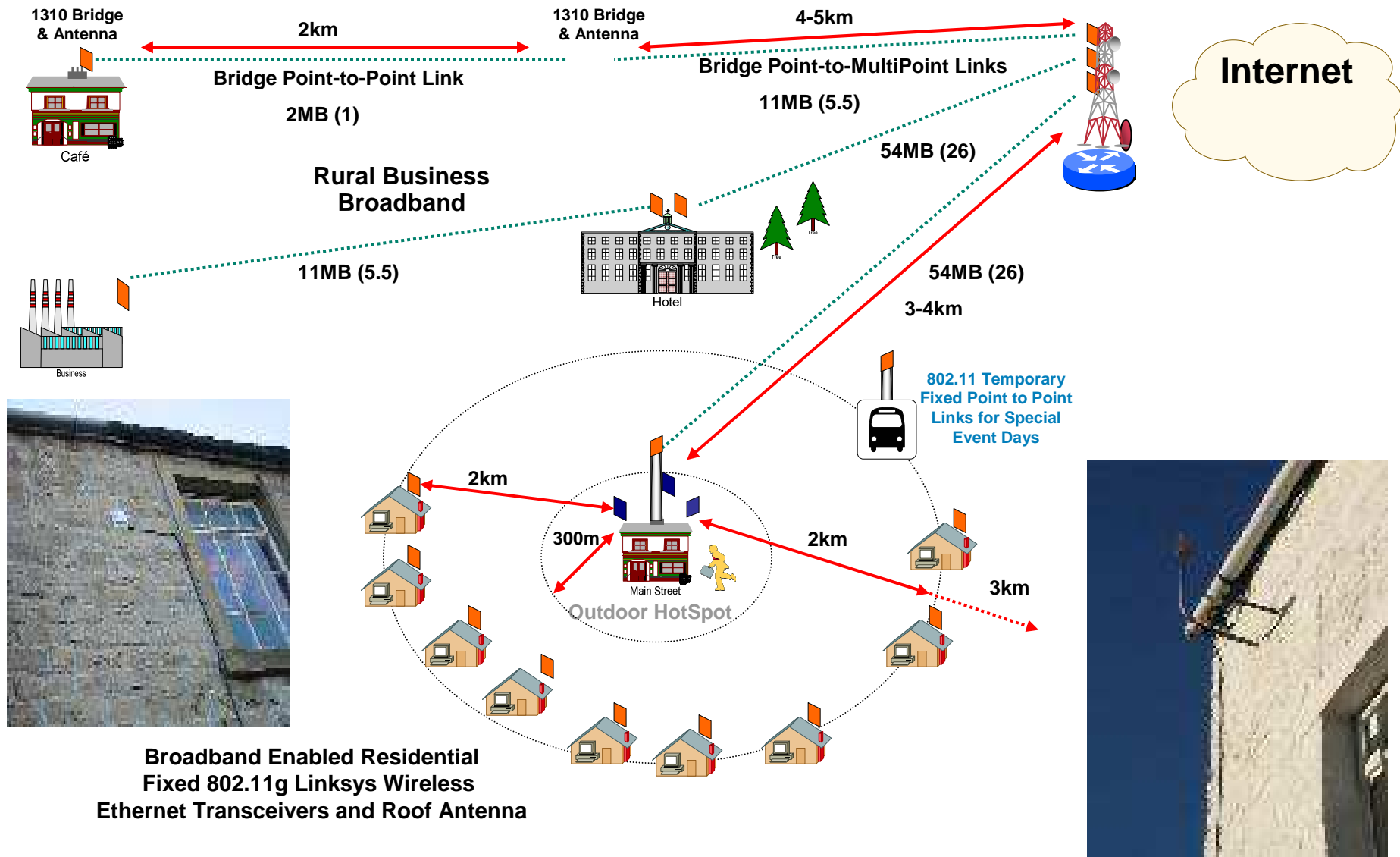
Addressing this opportunity with WiFi and unlicensed spectrum

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- **Lots of activity is focused on using WiFi to go after this opportunity**
- **WiFi is cheap and it uses unlicensed spectrum.... this combination seems to be a winner in the rural areas where small WISPs are deploying the service**
 - They do not have the deep pockets of the big telcos**
- **WiFi also has the advantage of:**
 - Lots of technical talent that is familiar with the technology**
 - Lots of investment in the technology**
 - Lots of standards work to extend this technology for other applications**
 - Lots of WiFi client devices already out there**
 - As well as the availability of additional unlicensed spectrum up in the 5 Ghz band**
- **Now what does a WiFi-based solution look like...**

Addressing the rural broadband opportunity with WiFi

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Addressing this opportunity with WiMAX

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- **Today's more traditional fixed wireless deployments use proprietary technologies**
This tends to keep the costs high, which is a big impediment to broad deployment
- **The WiMAX effort should help to standardize equipment and bring down costs, which should help accelerate the market**
- **In addition to lower cost network equipment, this market needs “zero install” CPE to succeed which implies:**
Smart antennas and lower frequencies for greater range and better building penetration
- **And WiMAX is a licensed technology, which should make it a better fit for the more traditional telco deployments that place a premium on providing a very high quality of service**

Conclusions

- **The metro opportunity is best supported by a mobile broadband service in licensed bands below 800 Mhz**

These bands lower the cost of deploying the service and greatly improve in-building coverage

- **The rural broadband opportunity can be supported with fixed wireless technology:**

Need to encourage build-outs by both the small WISPs and the big telcos

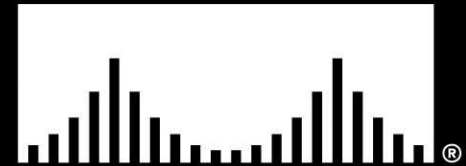
Need to support a variety of different wireless technologies, some that use licensed and others that use unlicensed technology (technology neutral)

Unlicensed will be key to getting this market rolling as it will encourage small operators to enter... but we must find ways to avoid the tragedy of the commons that is often an issue with unlicensed bands

Are there hybrid licensing approaches that would encourage small operators to enter the market without an up-front financial commitment for licensed spectrum

Questions

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